

WHAT IS CLAIMED IS:

1. A method of manufacturing a fiber reinforced cement composite material, comprising:

providing cellulose fibers;

treating at least a portion of the cellulose fibers with a sizing agent in the presence of water or an organic solvent, wherein the sizing agent comprises a hydrophilic functional group and a hydrophobic functional group, wherein the hydrophilic group chemically bonds to at least some of the hydrophilic sites on inner and outer surfaces of the fibers to form sized fibers, wherein the sizing agent substantially blocks the hydrophilic sites, thereby reducing the fibers' affinity toward water;

mixing the sized fibers with a cementitious binder and other ingredients to form a fiber cement mixture;

forming the fiber cement mixture into a fiber cement article of a pre-selected shape and size; and

curing the fiber cement article so as to form the fiber reinforced composite building material.

2. The method of Claim 1, wherein treating the fibers comprises treating the cellulose fibers in a solution containing sizing agents.

3. The method of Claim 2, wherein treating the fibers in solution comprises applying between about 0.01 to 50% of sizing agents to the fibers by fiber mass.

4. The method of Claim 2, wherein treating the fibers in solution comprises having a reaction retention time of between about 5 seconds to 28 hours.

5. The method of Claim 2, wherein the fibers are treated at a reaction pressure between about 1 and 10 atm.

6. The method of Claim 2, wherein treating the fibers in solution comprises the reaction of fibers and sizing agents is carried out in a slurry containing about 0.01 to 50% fibers by weight.

7. The method of Claim 1, wherein treating the fibers comprises using a dry spray process to deposit sizing agents on the inner and outer surfaces of the fibers.

8. The method of Claim 1, further comprising processing the sized fibers by dispersing the fibers at a pre-selected consistency range and then fibrillating the sized fibers to a pre-selected freeness range.

9. The method of Claim 8, wherein processing the sized fibers comprises dispersing the sized fibers at a consistency of 1%-6% in a hydra-pulper.

10. The method of Claim 8, wherein processing the sized fibers comprises fibrillating the sized fibers to a freeness of about 100 to 750 degrees of Canadian Standard Freeness (CSF).

11. The method of Claim 8, wherein processing the sized fibers comprises fibrillating the sized fibers to the freeness of about 180 to 650 degrees of Canadian Standard Freeness (CSF).

12. The method of Claim 1, further comprising flash drying the sized fibers to a moisture content of about 5% to 50%.

13. The method of Claim 12, wherein the sizing agent is applied to the fibers before or during flash drying of the fibers.

14. The method of Claim 1, further comprising mixing the sized cellulose fibers with unsized cellulose fibers.

15. The method of Claim 1, further comprising mixing the sized cellulose fibers with natural inorganic fibers and synthetic fibers.

16. The method of Claim 1, further comprising mixing the sized fibers with a cementitious binder, an aggregate, density modifiers and additives.

17. The method of Claim 1, wherein forming the fiber cement article comprises forming the article using a process selected from the group consisting of a Hatschek sheet process, a Mazza pipe process, a Magnani process, injection molding, extrusion, hand lay-up, molding, casting, filter pressing, Fourdrinier forming, multi-wire forming, gap blade forming, gap roll/blade forming, Bel-Roll forming, and combinations thereof, or other processes.

18. The method of Claim 1, wherein curing the fiber cement article comprises pre-curing and curing.

19. The method of Claim 18, wherein the fiber cement article is pre-cured for up to 80 hours at ambient temperature.

20. The method of Claim 18, wherein the fiber cement article is pre-cured for up to 24 hours at ambient temperature.

21. The method of Claim 18, wherein the fiber cement article is cured in an autoclave.

22. The method of Claim 21, wherein the fiber cement article is autoclaved at an elevated temperature and pressure at about 60 to 200°C for about 3 to 30 hours.

23. The method of Claim 21, wherein the fiber cement article is autoclaved at an elevated temperature and pressure at about 60 to 200°C for about 24 hours or less.

24. The method of Claim 1, wherein the fibers are individualized.

25. The method of Claim 1, wherein the sizing agents are applied to the fibers before they are individualized.

26. The method of Claim 1, wherein the sizing agents are applied to the fibers while they are individualized.

27. The method of Claim 1, wherein the sizing agents are applied to the fibers after they are individualized.

28. The method of Claim 1, wherein the fibers are individualized by processes including hammermilling and shredding.

29. The method of Claim 1, wherein the sizing agents are directly added to the fibers before mixing with other ingredients.

30. A method of manufacturing a building material incorporating reinforcing fibers, comprising:

chemically treating at least a portion of the reinforcing fibers in the presence of water or an organic solvent to improve the fiber's resistance to water and/or environmental degradation, wherein the reinforcing fibers are individualized;

mixing the reinforcing fibers with a hydraulic binder to form a mixture;

forming the mixture into an article of a pre-selected shape and size; and

curing the article so as to form the fiber reinforced building material.

31. The method of Claim 30, further comprising individualizing the fibers prior to said chemical treatment.

32. The method of Claim 30, further comprising individualizing the fibers after said chemical treatment.

33. The method of Claim 30, wherein the fibers are chemically treating comprising bringing a chemical compound in contact with the fibers.

34. The method of Claim 33, wherein a chemical reaction takes place between the fibers and the chemical compound upon contact of the chemical compound with the fibers.

35. The method of Claim 30, wherein the chemical treatment occurs at a temperature less than about 100°C.